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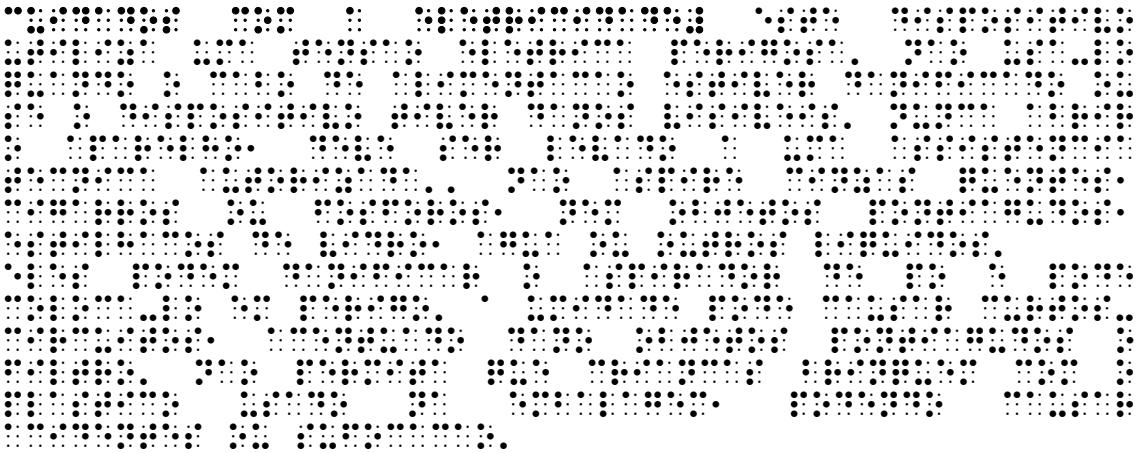

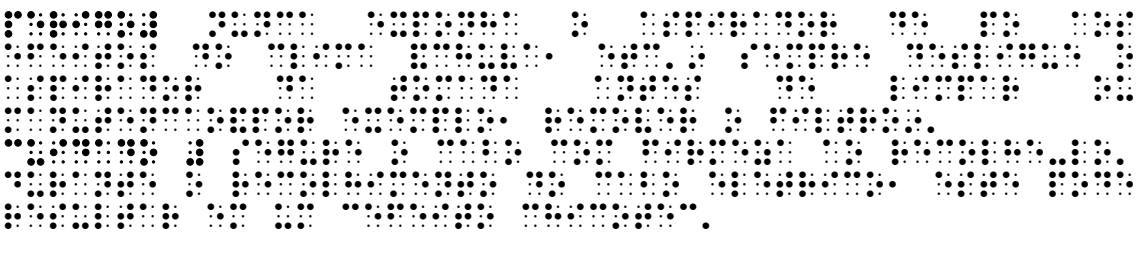

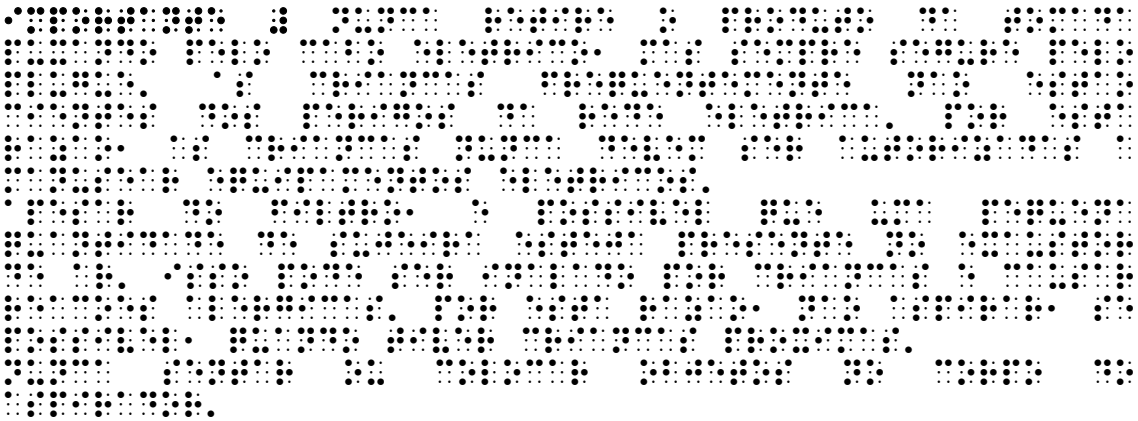

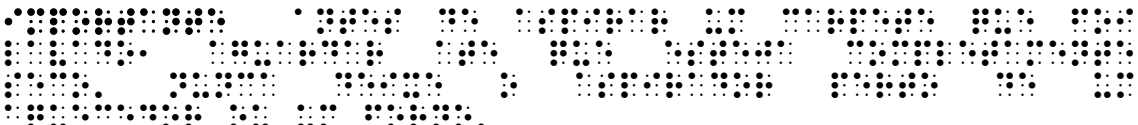

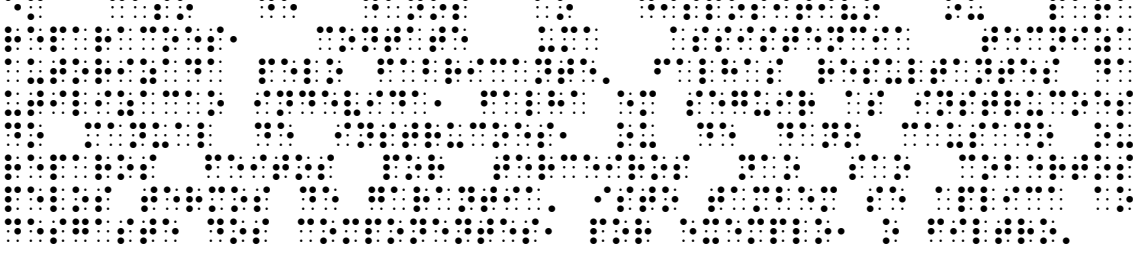

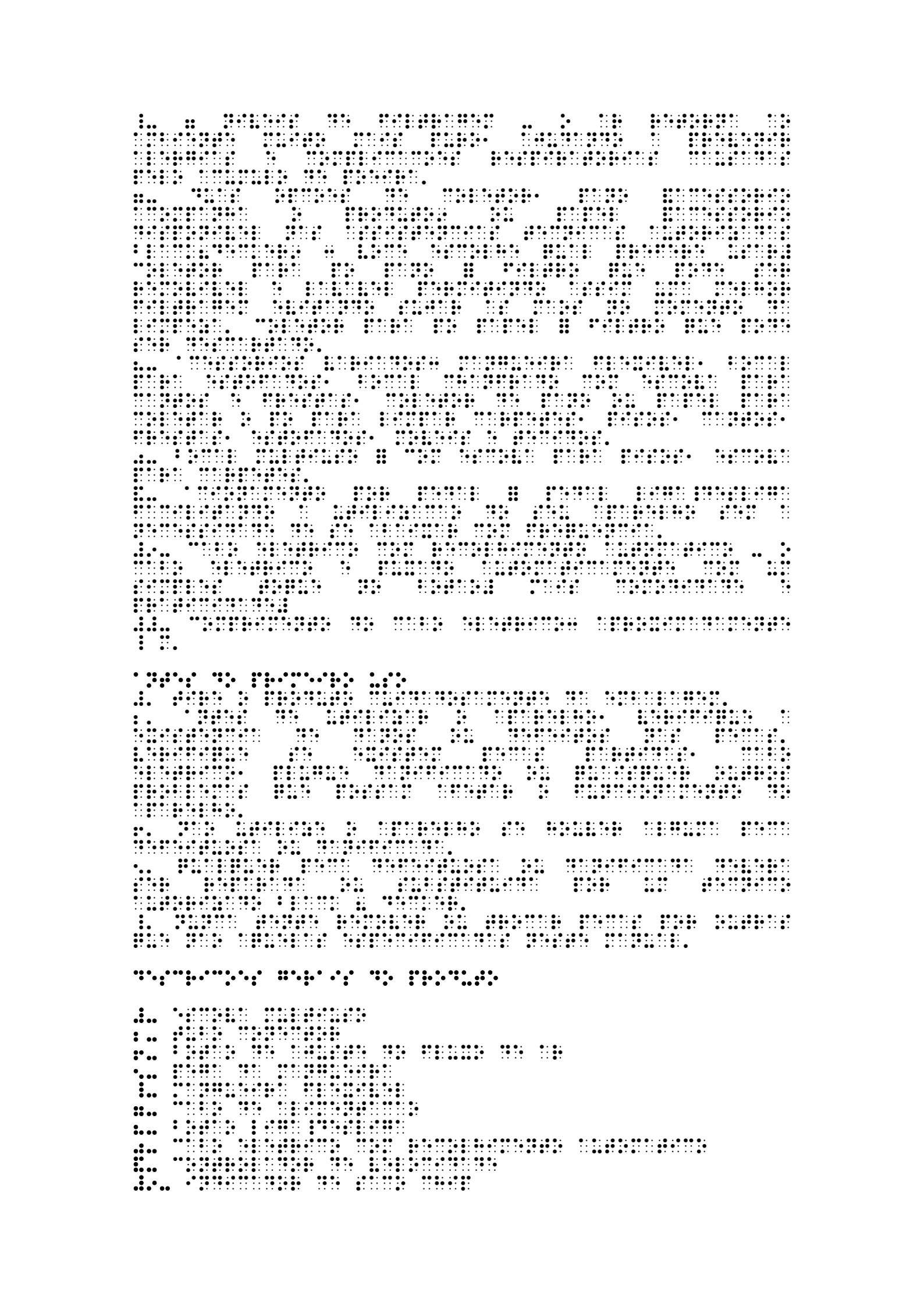

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Preface

Machine learning has become one of the most transformative technologies of the twenty-first century. From recommendation systems that suggest what we watch and buy, to medical diagnostics that can detect disease earlier than human experts, to autonomous vehicles navigating complex urban environments, machine learning algorithms are reshaping nearly every aspect of modern life. This book aims to provide a comprehensive yet accessible introduction to the field, suitable for students, practitioners, and curious readers alike.

The motivation for writing this book arose from a simple observation: most existing textbooks on machine learning fall into one of two categories. They are either highly theoretical, filled with dense mathematical proofs that obscure the practical intuition behind the algorithms, or they are purely practical, offering recipes for using software libraries without explaining why those recipes work. We believe that a good understanding requires both theory and practice, and we have tried to strike a balance between the two throughout this book.

Each chapter begins with a motivating example or real-world problem, introduces the relevant concepts and algorithms, and then provides hands-on exercises that reinforce the material. We have included Python code examples using widely available open-source libraries, and we encourage readers to run the code themselves and experiment with modifications. Learning by doing is the most effective way to develop genuine understanding.

We would like to thank our colleagues, students, and reviewers who provided feedback on early drafts of this manuscript. Their comments helped us improve the clarity and accuracy of the text. Any remaining errors are entirely our own responsibility.

How to Use This Book

This book can be used in several ways depending on your background and goals. If you are new to machine learning, we recommend reading the chapters in order, as later chapters build on concepts introduced earlier. If you already have some experience, you may wish to skip directly to the topics that interest you most. Each chapter is largely self-contained, with clear cross-references to prerequisite material.

The exercises at the end of each chapter are divided into three levels of difficulty. Level 1 exercises test basic comprehension and can usually be solved by applying the methods described in the chapter. Level 2 exercises require more thought and may combine ideas from multiple sections. Level 3 exercises are open-ended projects that can serve as the basis for a longer assignment or a capstone project.

Prerequisites

We assume that the reader has a basic understanding of linear algebra, calculus, and probability theory. Specifically, you should be comfortable with vectors and matrices, derivatives and gradients, and the concepts of random variables and probability distributions. If you need a refresher, we recommend the appendix on mathematical background, which covers the essential results we will use throughout the book.

For programming, we assume familiarity with Python and the NumPy library. Some exercises also use Matplotlib for visualization. We have deliberately avoided using high-level machine learning frameworks in the early chapters so that the reader can see how the algorithms work under the hood before relying on abstractions.

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Introduction

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Related work

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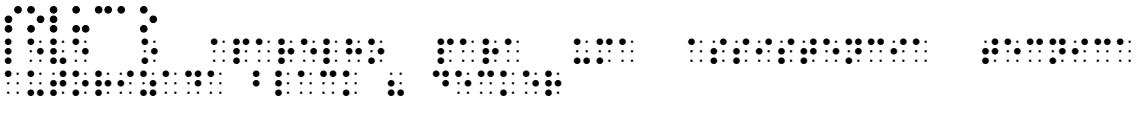

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Ours	78.9	15 ms

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Conclusion

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